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CARVALHOFULVIUS GIGANTOCHLOAE, A NEW GENUS AND SPECIES OF BAMBOO-INHABITING FULVIINI FROM WEST MALAYSIA (HETEROPTERA: MIRIDAE: CYLAPINAE)

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Abstract.—***Carvalhofulvius gigantochloae***, a new genus and species of fulviine Miridae from West Malaysia is described and illustrated. This bug lives inside the shoot internodes of *Gigantochloa scortechinii* (Poaceae: Bambusoideae), where it apparently feeds on developing fungal hyphae. The tribal placement of *Carvalhofulvius* and its relationship to other fulviine mirids are discussed. Biological information is provided, including a summary of a field study of colonization densities on different internode types (e.g. shoots, older culms).

Key Words: Heteroptera, Miridae, Fulviini, *Carvalhofulvius,* new genus, West Malaysia, bamboo-inhabiting, phytotelmata, biology

An ongoing study of the arthropod species inhabiting internodes of the giant bamboo, *Gigantochloa scortechinii* Gamble, in West Malaysia (coordinated by DK) has revealed an interesting species of fulviine Miridae that cannot be placed in any known genus of the tribe. *Carvalhofulvius gigantochloae,* new genus and new species, is here described and illustrated; its biology, placement in the Fulviini, and relationship to other fulviine genera are discussed.

Institute abbreviations used to record the depositories of types and other specimens are as follows: American Museum of Natural History, New York (AMNH); Forschunsinstitut Senckenberg, Frankfurt (FS); National Museum of Natural History, Washington, D.C. (USNM); Natural History Museum, London (NHM).

All measurements are given in millimeters.

Carvalhofulvius Stonedahl and Kovac, NEW GENUS
(Figs. 1–14)

Type species.—*Carvalhofulvius gigantochloae,* new species, here designated.

Diagnosis.—Distinguished from other genera of Fulviini by the long head, with eyes well removed from anterior margin of pronotum (Figs. 1, 2, 9); enlarged profemora, with two irregular rows of socketed spines ventrally (Figs. 6, 8); and by the structure of the male genitalia, especially the various sclerotized appendages of the vesica (Fig. 14).

Description.—Male. Macropterous; dark brown to nearly black with pale markings at base of hemelytra and apex of corium; dorsal surface finely granular, slightly shining; posterolateral regions of pronotum finely wrinkled; dorsal vestiture of short, stout,

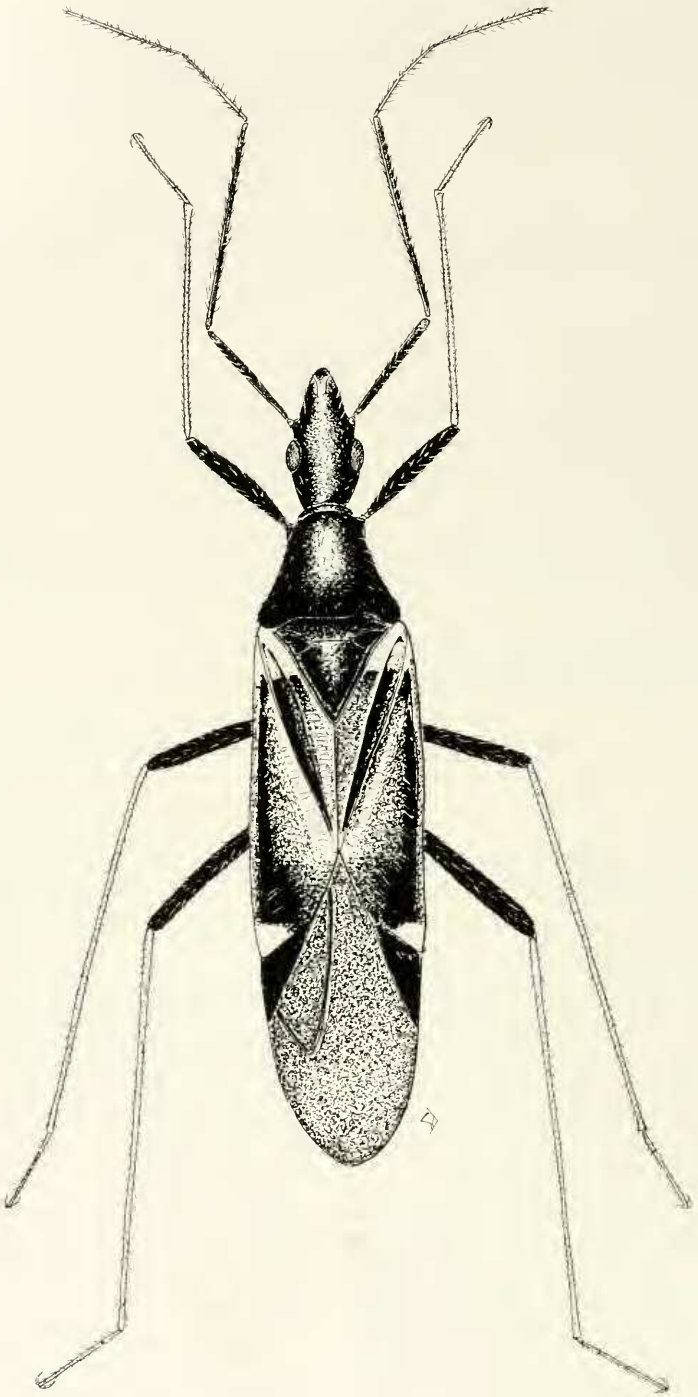
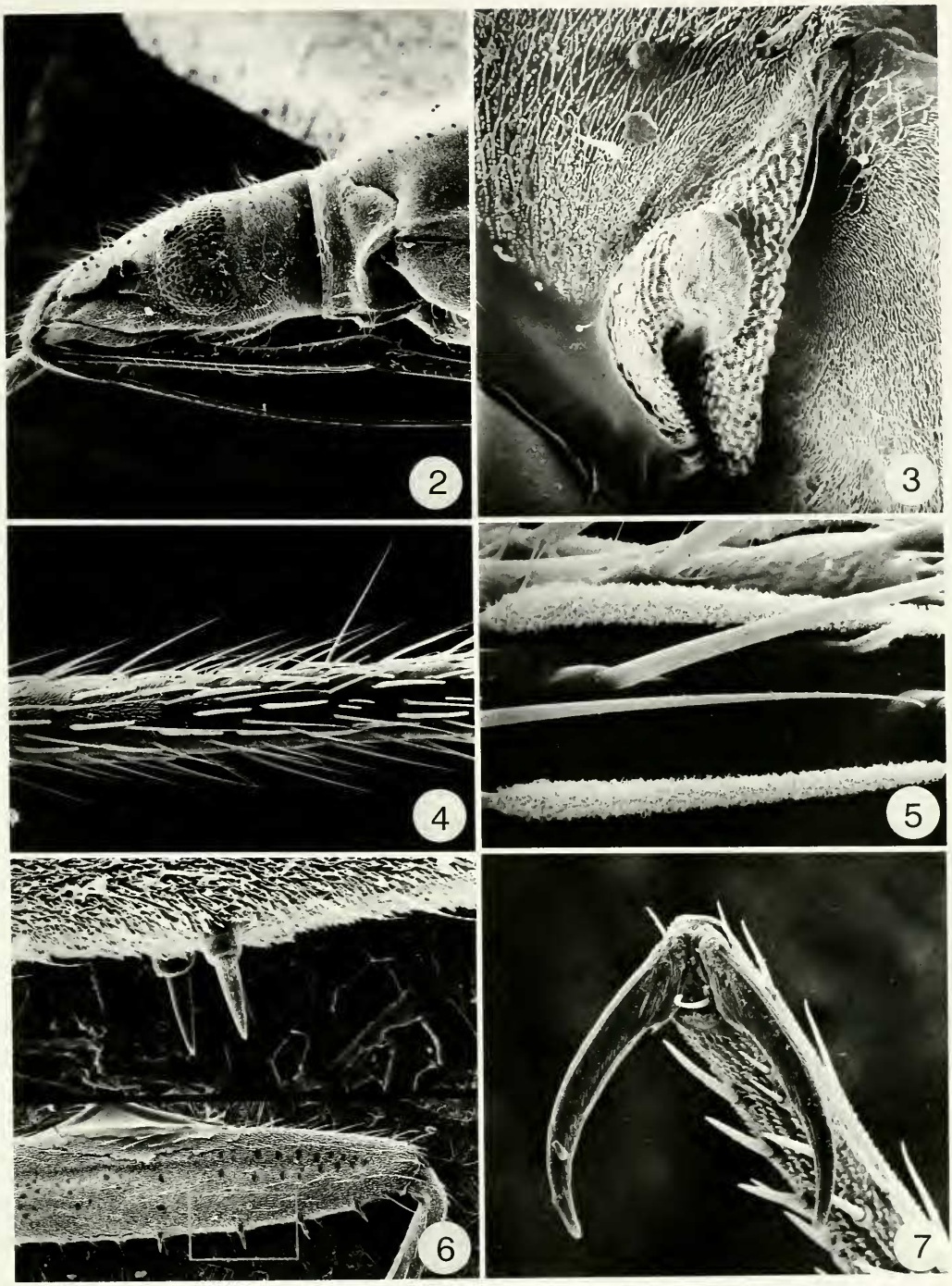
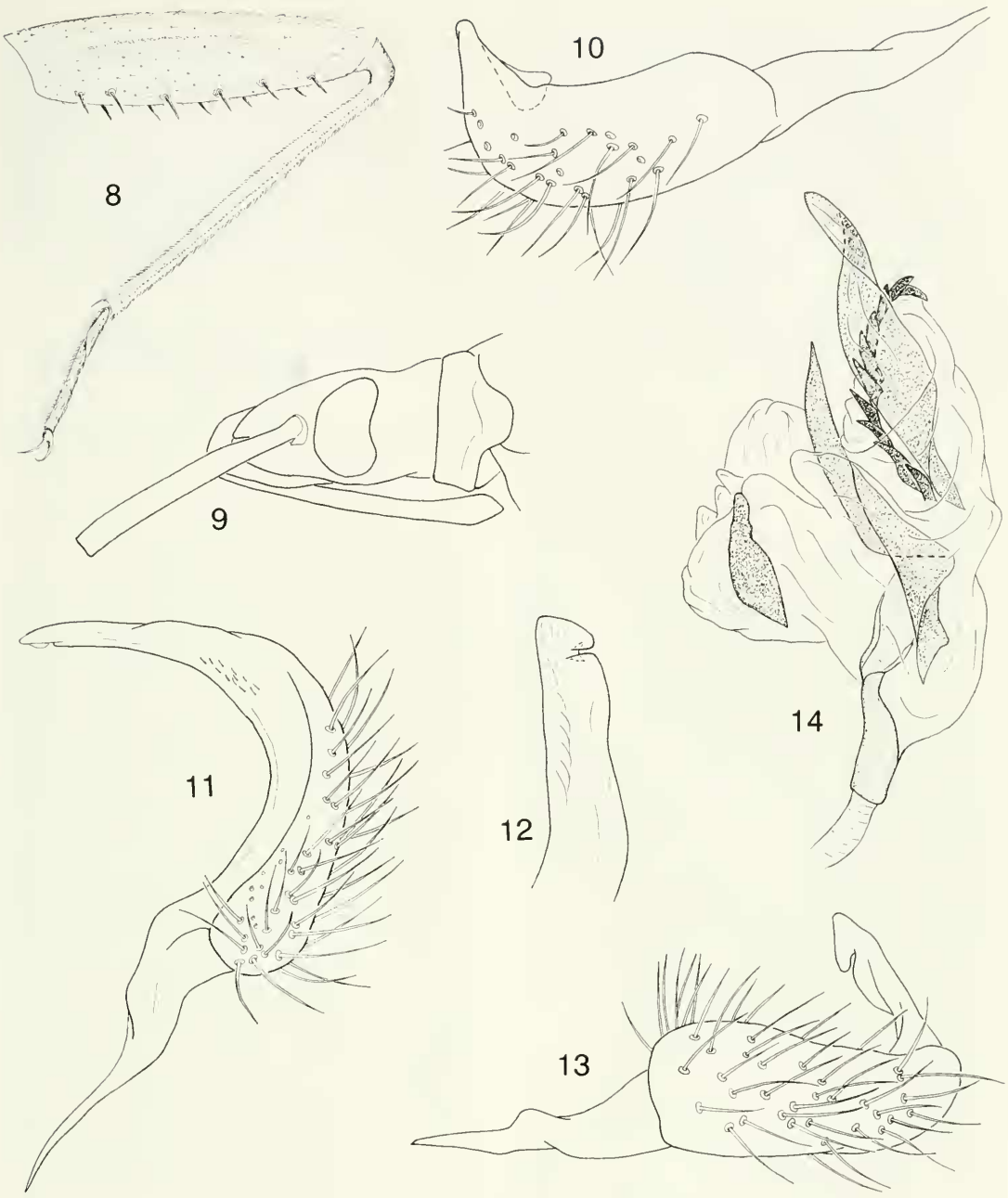


Fig. 1. *Carvalhofulvius gigantochloae*, n. sp., dorsal habitus of male.



Figs. 2–7. Scanning electron micrographs of *Carvalhofulvius gigantochloae*. 2, lateral view of head. 3, metathoracic scent efferent system. 4, distal third of antennal segment II. 5, detail of woolly setae on antennal segment II. 6, lateral view of profemora showing socketed spines on ventral surface. 7, pretarsus, posterior view.

suberect, dark setae, usually slightly longer and more densely distributed along lateral margins of pronotum, sparsely distributed on hemelytra, except more common along veins. *Head:* Length about equal to median length of pronotum; strongly produced anterior to eyes (Figs. 1, 2, 9); eyes small, pubescent, weakly protruding from head, removed from anterior margin of pronotum by distance equal to their width in lateral view, reaching ventrally to gular ridge; head posterior to eyes slightly depressed dorsally, weakly inflated laterally; frons nearly flat, gradually declining from vertex to tylus; tylus moderately prominent, distal half strongly declivous; maxillary and mandibular plates prominent; bucculae well developed, reaching posteriorly to level of anterior margin of eyes; buccal cavity ovate; genae very narrow, nearly obsolete, bordered ventrally by distinct gular ridge; gula broadly developed, depressed; labium reaching to base of genital capsule or slightly beyond, segment I reaching onto xyphus, segments II and III slightly longer than I, segment IV about half as long as III. *Antennae:* Cylindrical, segments I and II similar in diameter, III and IV narrower; inserted at median level of eye, fossae removed from anterior margin of eye by distance equal to diameter of antennal segment II; segment I about as long as head, reaching well beyond apex of tylus in lateral view; segment II slightly more than twice as long as I; length of segment III slightly less than I; length of segment IV about equal to segment I; all segments with suberect, dark setae, segment II also with some narrow, reclining, woolly setae ventrally and distally (Figs. 4, 5), segments III and IV with scattered, longer, pale setae. *Thorax:* Pronotum trapeziform, without distinct anterior and posterior lobes; anterior margin in the form of a flattened collar, about as broad as diameter of antennal segment I; lateral margins sinuate, weakly carinate posteriorly; posterior margin with deep, subquadrate excavation medially; calli strongly prominent, occupying most of anterior two-thirds of pronotum, confluent medially, reaching lateral margins of pronotum anteriorly. Mesoscutum broadly exposed. Scutellum weakly elevated. Metathoracic scent efferent system with evaporative area narrowly developed; peritremal disc small, moderately raised, tongue-shaped, densely pubescent (Fig. 3). *Hemelytra:* Elongate, parallel-sided; embolium broadening slightly distally; cuneus about three times as long as broad; cuneal incisure shallow, fracture well developed; membrane reaching well beyond apex of abdomen, primary cell much longer than broad, secondary cell narrowly triangular. *Legs:* Profemora noticeably enlarged, with two irregular rows of large, socketed spines ventrally (Figs. 6, 8); meso- and metafemora narrower, nearly linear, without spines; tibiae cylindrical, set with four rows of dark spinules and some longer, pale setae; tarsi cylindrical, two-segmented, segment II twice as long as segment I (Fig. 8); pretarsus with long weakly curved claws, short setiform parempodia and no pulvilli (Fig. 7). *Genitalia:* Genital capsule subquadrate, with strongly developed posterodorsal margin; aperture bridged medially by flattened sclerite originating from dorsal margins of paramere sockets. Left paramere with sensory lobe moderately produced, gradually tapering to broad U-shaped angle, outer surface with long, pale setae; shaft slightly shorter than arm, with distinctly notched apex (Figs. 11–13). Right paramere lance-shaped, with strongly narrowed, curved apical region; outer surface with long pale setae; inner-dorsal surface with flattened, toothlike process (Fig. 10). Phallotheca strongly asymmetrical, broadly opened distally. Vesica with ductus seminis terminating in weakly sclerotized tube with expanded posterodistal margin; secondary gonopore indistinct, unmodified, positioned at base of distal expansion of ductus seminis; primary membranous sac of vesica multilobed, with three sclerotized appendages: smallest, flattened sclerite originating near left distal margin of



Figs. 8–14. *Carvalhofulvius gigantochloae*. 8, lateral view of proleg. 9, lateral view of head. 10–14, male genitalia. 10, right paramere, lateral view. 11, left paramere, dorsal view. 12, apex of left paramere, lateral view. 13, left paramere, lateral view. 14, vesica.

sclerotized tube; larger, coiled, cone-shaped sclerite originating near right basal margin of sclerotized tube; strongly twisted, lance-shaped sclerite lying right and distal to cone-shaped sclerite (position of all sclerites described in uninflated vesica with secondary gonopore in dorsal orientation—Fig. 14); vesica also with 8–12 strong spines rimming

distal margin of membranous sac, these wrapping around posterobasal region of lance-shaped sclerite in uninflated vesica.

Female.—Macropterous; similar to male in color and general structure, except first antennal segment relatively shorter and hemelytra not reaching as far beyond apex of abdomen; genitalia not examined.

Distribution.—West Malaysia.

Etymology.—Named in honor of José C. M. Carvalho for his extensive and lasting contributions to the systematics of the Miridae on a worldwide scale.

Discussion.—Based on the tribal characterizations presented by Poppius (1909), Carvalho (1955, 1978) and Schmitz and Stys (1973), *Carvalhofulvius* belongs to the Cylapinae tribe Fulviini. The primary characters supporting this placement are the elongate head with horizontal frons and strongly developed gula; enlarged, medially confluent calli, occupying most of anterior two-thirds of pronotum; conical coxae, with front pair much larger than middle and hind pairs; and pretarsus with long, weakly curved claws, setiform parempodia and no pulvilli.

Schmitz and Stys (1973) elevated the fulviines to subfamily rank, offering among other supporting evidence, the unique female reproductive system and egg-laying habit. Schuh (1976) considered the proposed change of status unwarranted, and neither Carvalho (1978) nor Schmitz (1978) supported a subfamily ranking in subsequent treatments of the group.

The relationship of *Carvalhofulvius* to other genera of Fulviini is uncertain, as are the generic relationships of most of the predominantly tropical Cylapinae. In Carvalho (1955: 19), *Carvalhofulvius* keys with difficulty to the genus *Fulvius* in couplet 11, and is superficially very similar to some of the larger species of this genus. However, *Carvalhofulvius* is easily distinguished from *Fulvius* by the characters of the head and profemora given in the generic diagnosis. We are not familiar enough with fulviine male genitalia to make more than general comments about these structures, but it appears from our examination of other published accounts (e.g. Carvalho 1978), that the vesica of *Carvalhofulvius* is much more heavily adorned with sclerotized appendages than is commonly found in the genus *Fulvius*. Obviously, a much broader survey of external and genitalic characters is required to accurately address the question of generic relationships.

Carvalhofulvius gigantochloae, Stonedahl and Kovac, New Species
(Figs. 1–14)

Diagnosis.—Recognized by the characters given in the generic diagnosis.

Description.—Male (n = 3). Length from apex of tylus to apices of hemelytra 5.62–6.30; width across hemelytra 1.20–1.42; surface texture and dorsal vestiture as in generic description. *Head:* Length 0.91–0.98, width across eyes 0.55–0.64, width of vertex 0.29–0.32; blackish brown with maxillary and mandibular plates and tylus somewhat paler; antennal segments I and II dark brown, II usually somewhat paler distally; antennal segment III brown, segment IV yellowish brown; length of antennal segment I 0.73–0.91, segment II 1.67–2.13; length of labium 3.42–4.27, segments I and IV brown or dark brown, segments II and III yellowish brown. *Thorax:* Pronotum uniformly blackish brown, except posterolateral margins sometimes slightly paler; posterior width of pronotum 0.98–1.20, median length 0.73–0.88; propleuron, mesoscutum and scutellum uniformly fuscous. *Hemelytra:* Dark grayish brown to nearly black; basal quarter of clavus, extreme base of corium, and posterolateral angle of corium white (Fig. 1); cuneus fuscous, sometimes tinged with red along inner margin; membrane uniformly infuscated, veins darkened. *Legs:* Femora dark brown, extreme base and apex usually paler yellowish brown; tibiae and tarsi pale yellow; pretarsal claws yellowish brown. *Genitalia:* Fig. 10–14.

Female (n = 5).—Length 5.47–6.00; width across hemelytra 1.13–1.28; length of head 0.91–0.97; width of head across eyes 0.55–0.60; width of vertex 0.32–0.36; length of antennal segment I 0.70–0.78, segment II 1.35–1.79; length of labium 3.15–4.34; median length of pronotum 0.69–0.81; posterior width of pronotum 1.03–1.17.

Distribution.—West Malaysia.

Etymology.—Named for its host plant, *Gigantochloa scortechinii.*

Holotype male.—West Malaysia. *Selangor Prov.:* Ulu Gombak Field Studies Centre, University of Malaya, 250 m, Sample 2, 8.XII.1993, ex shoot internode (no. 10) of *Gigantochloa scortechinii,* D. Kovac (AMNH).

Paratypes.—West Malaysia. *Selangor Prov.:* 1 female, same data as holotype (AMNH); 1 female, same data as holotype, except Sample 1, 13.XI.1993, internode of decaying shoot of *G. scortechinii* on ground (FS); 1 male, 1 female, same data as holotype, except Sample 3, 2.XII.1993, internode (no. 6) of *G. scortechinii* (FS); 1 female, same data as holotype, except Sample 4, 30.XI.1993, internode (no. 9) of *G. scortechinii* (FS); 1 male, 1 female, same data as holotype, except Sample 5, 23.XI.1993, internode (no. 5) of *G. scortechinii* (NHM).

Additional specimens.—West Malaysia. *Selangor Prov.:* Ulu Gombak Field Studies Centre, University of Malaya, 250 m: 3 males (1 damaged, 1 teneral), 15.VI.1989; 2 females, 18.III.1989; 1 male (teneral), 9.V.1989; 1 female, 16.VI.1989; all from internodes of *G. scortechinii,* D. Kovac (FS).

The specimens collected in March–June, 1989 are smaller on the average (males 3.8–5.5; females 4.7–4.9) than those collected in November and December, 1993. However, the external characters and male genitalia of the smaller specimens are consistent with those of the holotype and paratypes, confirming that the two groups of specimens are conspecific. The 1989 specimens were not measured or included here as paratypes primarily because of their poor condition.

Biology.—Although several Miridae are known to be strictly associated with bamboo in Asia (Zheng, 1994 recorded four species from China), *Carvalhofulvius gigantochloae* is the only species that lives inside the internodes of bamboo shoots. It has been collected in Peninsular Malaysia from *Gigantochloa scortechinii, G. latifolia* Ridl. and *Dendrocalamus pendulus* Ridl. The following biological account was compiled from observations made by DK on *G. scortechinii,* a bamboo species endemic to the Malay Peninsula, whose culms grow 25 m tall (internode length 20–60 cm, diameter 8–10 cm). The bug gains access to the internodes through holes made by other insects or through cracks in the internode wall. Holes as small as 1.9 × 0.9 mm, such as those made by larvae of the leaf beetle *Lasiochila goryi* (Guér.), allow *C. gigantochloae* easy access to bamboo internodes. All internodes investigated were partially filled with water that had entered through holes or cracks after rainstorms. These small water reservoirs within bamboo shoots, sometimes referred to as phytotelmata, create a unique environment supporting a rich fauna of aquatic and terrestrial insects (for details see Kovac 1994 and Kovac and Streit 1994).

Different internode types (e.g. young, old, living, decaying) exhibit differential colonization densities of *C. gigantochloae.* Young shoots are much preferred to older culms—20.6% of the internodes examined in standing shoots were inhabited, while only 1–2% of the internodes of older culms were colonized. Bugs were found only in the lower section of the shoots from just above the ground to a height of four meters. Older felled culms in a state of decomposition showed higher levels of colonization. In a six-month investigation of 100 internodes taken from 10 felled culms, bugs were observed in a total of 28 internodes, with up to 11 internodes inhabited simultaneously. The majority (19) of inhabited internodes belonged to just two of the 10 culms studied.

Internodes of felled shoots were colonized

by both adults and nymphs of *C. gigantochloae*. Some bugs stayed in the same internodes for up to 2.5 months, but stays of shorter duration were much more common. Development from egg to adult was estimated to take somewhere in the range of 45–60 days. In one case, a new generation of bugs reached the adult stage 59 days after the appearance of the initial colonizing adult. The first copulation was seen seven days after the last molt. No observations were made on oviposition sites.

Carvalhofulvius gigantochloae was seen to touch the moist substrate of the inner wall with its labium while walking, often in close vicinity to the water surface. In two cases, the stylets were seen to be inserted into moist debris which contained fungal hyphae. Fungi may well be the staple food of this mirid species, a feeding habit consistent with that reported for other fulviine Miridae (Schuh 1976, Wheeler and Wheeler 1994). The bug prefers damp places in which an intense decomposition of wall substance of the bamboo occurs. This is true for both the inner walls of living shoots after a connection to the outside environment has been created and the wall of dead culms that decompose completely. In older living culms, only the inner nutrient-rich layer decomposes, while the remaining wall substance remains intact. Dead stumps of bamboo culms are another particularly favorable habitat for *C. gigantochloae*.

In the course of the six-month investigation of felled older culms there were eight observations of predation on *C. gigantochloae* by internode-inhabiting predators. Two adult bugs and one nymph were found in the webs of theridiid spiders, one nymph was captured by a jumping spider of the subfamily Spartaeinae and three nymphs were attacked by the assassin bug *Emesopsis* sp. Another nymph had apparently fallen onto the water surface and then been caught by the waterstrider *Baptista* sp.

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